Space Weather Technical Forecast

Issued on Sunday, 04 August 2024 at 01:11 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: M-flares expected, chance of X-flares and of exceeding S1/Minor Radiation Storm threshold. Possible glancing CME influence early Day 1 (04 Aug). Chance of G1/Minor Geomagnetic Storm.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity is High. A peak impulsive flare of M7.3 was observed at 03/1839 UTC from AR3775 in the northeast, and an M5.3 flare was observed at 03/1930 UTC from a sunspot just around the east limb, probably originating from Ex-3744, which is due to rotate onto the disc in next day or so. These two M-flares produced R2 radio blackouts. No CMEs are currently evident in coronagraph imagery from these two events.

An active disc, with thirteen sunspot regions currently on the visible disc. AR3765, AR3766 and AR3767 remain clustered close together in the southwestern disc. AR3765 and AR3767 are still in very close proximity, with the respective trailing and leading portions sharing a penumbra with a delta spot configuration. These regions are increasingly difficult to analyse as they approach the limb, with the previous classification being maintained. AR3772 in the southeast maintains a strong delta in one of its intermediate spots. AR3774 in the southeast quadrant has reduced in magnetic complexity. The leading and trailing spots on AR3775 are pulling apart, with the delta spot separated as well. AR3777 has continued to develop with signs of minor growth in its trailing and intermediate spots, although this region is still difficult to analyse due its location. All other regions appear generally stable at present.

No Earth directed CMEs have been observed in the past 24 hours.

Solar Wind / Geomagnetic Activity: The solar wind, as measured by ACE at L1, has declined down to background levels. Wind speeds were initially near 400 km/s, declining to around 330 km/s. Density has been largely below average. The Interplanetary Magnetic Field, Bt, was initially weak, but gradually increased to Moderate, peaking at 9nT. The north-south component, Bz, varied weakly between +6/-7nT. Phi angle was largely positive (away from the Sun). Geomagnetic activity was Quiet to Unsettled (Kp 1-3).

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux observed by GOES18 was at background levels. High energy electron flux (greater than 2MeV) observed at GOES16 was also at background levels. The 24-hour fluence was below the Active threshold with 1.2e6 integrated pfu observed at 04/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Moderate to High activity is forecast to continue, with occasional M-class flares expected and a chance of isolated X-class flares.

Solar Wind /Geomagnetic Activity: The shock from a CME originating from AR3768 at 01/0709UTC could give Earth some glancing influence early Day 1 (04 Aug). There has already

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been some evidence of this CME arriving at Stereo-A (ahead of Earth), although no evidence of its arrival at L1 at present. Due to the large number of coincident CMEs in recent days, further arrivals cannot be ruled out through the period.

No coronal hole fast wind enhancements are expected during the period, with CME arrivals expected to be the main factor of interest. Geomagnetic activity is expected to be generally Quiet to Unsettled, with periods of Active to G1/Minor Storms with a Slight Chance of G2/Moderate Storms should any CME arrivals bring more than a glancing blow. In the absence of further CME influence, activity is likely to become mostly Quiet later in the period.

Energetic Particles / Solar Radiation: High energy proton flux is currently at background levels. Should any notable flares occur in the western disc there is a chance of exceeding the S1/Minor Radiation Storm threshold. The high energy electron flux is forecast to be mostly at background levels, although perhaps rising later in the period if CME influence wanes. The associated 24-hour fluence is likely to remain below the Active threshold (1e8 integrated pfu), with a slight chance of exceeding by the end of the period.

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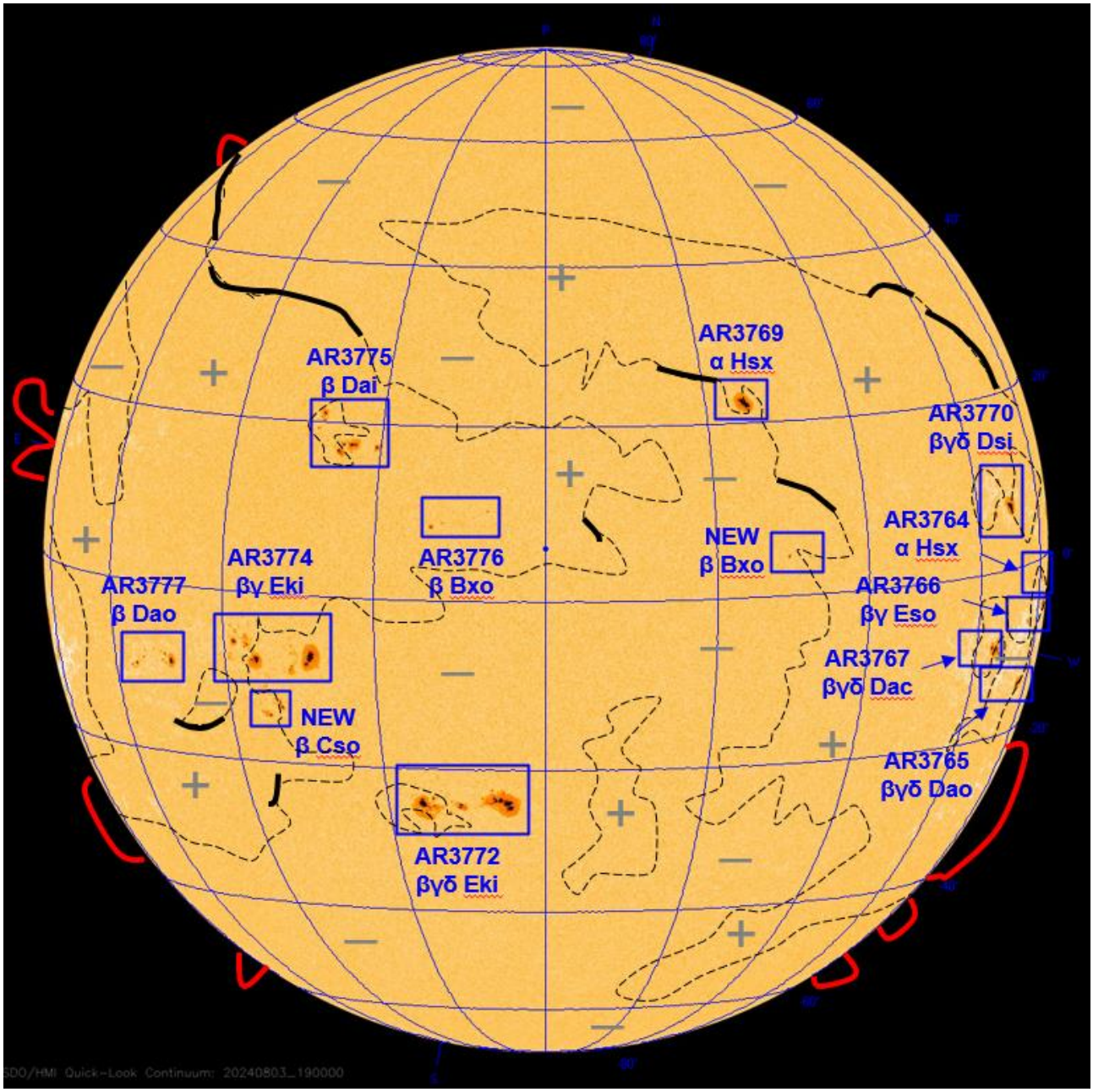
Figure 1. Solar Analysis Valid 03/1900 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

The bulk of a broad CME from the M8.2 flare at 01/0709UTC from AR3768 is largely passing ahead of Earth, as indicated by Enlil. However, SOHO coronagraph imagery showed a partial halo shock (not modelled in Enlil), which could possibly give Earth some glancing influence early on Day 1 (04 Aug). There is already evidence of this CME arriving at Stereo-A (which is ahead of Earth), although no evidence of its arrival at L1 at present, which may suggest the bulk of the CME has passed near to Earth.

Due to the large number of coincident CMEs in recent days, including those off the Earth-Sun line, analysis has been more difficult than usual. Consequently further arrivals cannot be ruled out through the period.

No coronal hole fast wind enhancements are expected during the period, with CME arrivals expected to be the main factor of interest. Geomagnetic activity is expected to be generally Quiet to Unsettled, with periods of Active to G1/Minor Storms with a Slight Chance of G2/Moderate Storms should any CME arrivals bring more than a glancing blow. In the absence of further CME influence, activity is likely to become mostly Quiet later in the period.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	30	5	5	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
01/1053	Partial	AR3768	SW limb	1148km/s	03/1800 UTC +/- 12 hours	Mostly shock expected

Figure 2: MOSWOC Enlil and ensemble. Main bulk of CME is modelled as passing ahead of Earth, but shock arrival is likely (not modelled).

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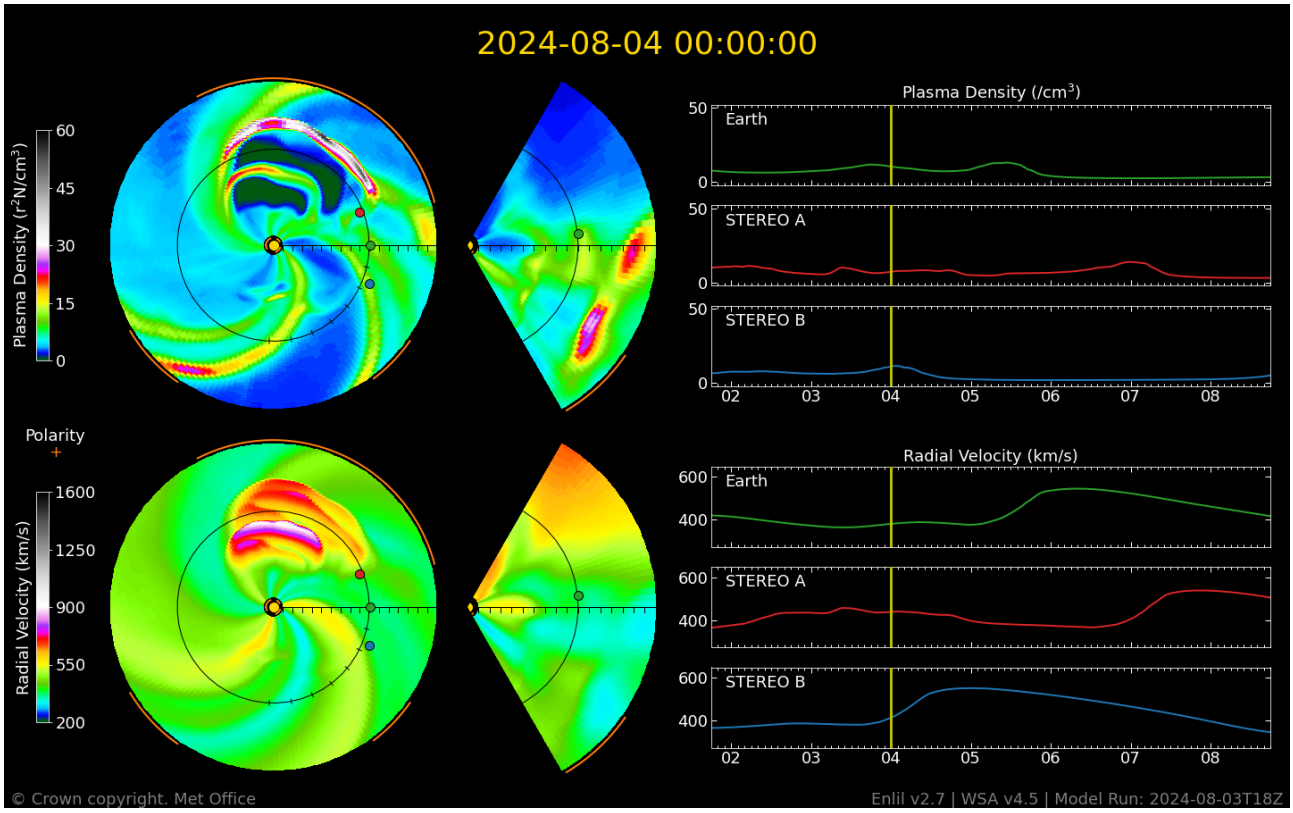

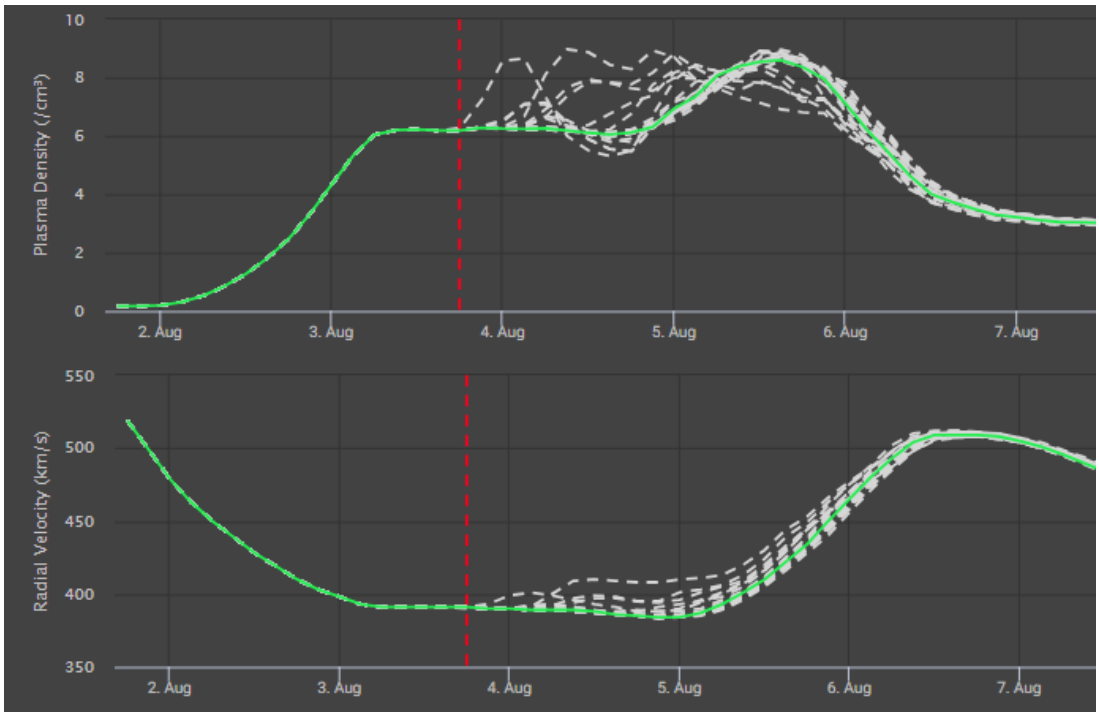

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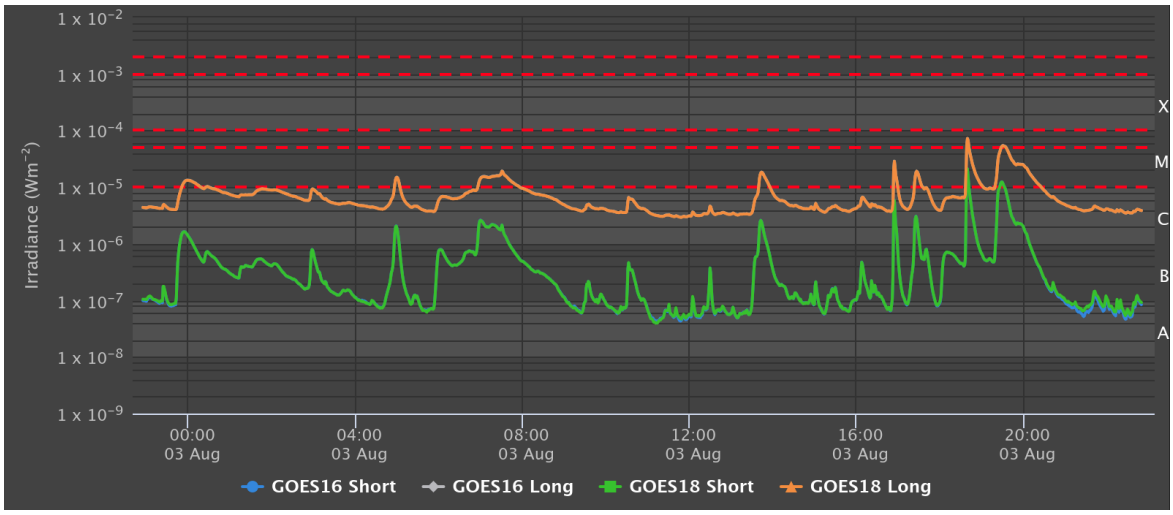
Radio Blackouts - X-Ray Flares:

An active disc, with thirteen sunspot regions currently on the visible disc, with two new regions developing - one in the northwest and the other just south of AR3774. Near the southwest limb, AR3765, AR3766 and AR3767 remain clustered close together. AR3765 and AR3767 are still in very close proximity, with the respective trailing and leading portions sharing a penumbra with a delta spot configuration. These regions are increasingly difficult to analyse as they approach the limb, with classification being maintained for the time being. AR3772 in the southeast maintains a strong delta in one of its intermediate spots. AR3774 in the southeast quadrant has lost its magnetic complexity. The leading and trailing spots on AR3775 are pulling apart, with the delta spot also having pulled apart. AR3777 has continued to develop with signs of minor growth in its trailing and intermediate spots, although this region is still difficult to analyse due its location. There are also hints of a further new region to rotate onto the southeast limb shortly. All other regions appear generally stable at present.

Far-side sounding data suggests the potential for at least one significant oncoming region by the end of this guidance period. Provisionally a slight drop in flare risk is suggested through Days 3-4 (06-07 Aug) as the cluster of active regions in the west leave the disc, although oncoming regions could potentially balance this decline. Overall Moderate to High activity is forecast to continue, with occasional M-class flares expected and a chance of isolated X-class flares given the large number of complex active regions currently on the disc and activity over recent days.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	90	80	70	70
Very Active	R3 to R5 X Class	No	25	20	20	20

Figure 3: GOES16 and 18 X-Ray flux showing multiple M-class flares over the past 24 hours.



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Solar Radiation Storms - (High Energy Protons):
High energy proton flux, as observed by GOES-18, is currently at background levels but has the potential to rise in response to any notable flares on the disc, particularly those from the west of the disc and therefore in a favourable position to give proton enhancement from any significant flare activity. This brings a chance of reaching the S1/Minor Radiation Storm levels, reducing slightly by the end of the period as active regions in the west increasingly rotate away.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	25	25	25	20
Very Active	**≥ S3 ***	No	5	5	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):
High energy electron flux, as observed by GOES-16, is currently at background levels having been suppressed by recent CME arrivals. Further CME arrivals are likely to keep the observed flux near background levels in the short term, but recent CME activity is likely to have caused an increase in electron flux below GEO. Assuming CME influence wanes during the period (an assumption where confidence is low), this will probably be reflected in an increase in electron flux later in the period, with moderate or perhaps high flux becoming possible at the diurnal peak on Days 2-4 (05-07 Aug).

The associated 24hr electron fluence is most likely to remain below Active (1e8 integrated pfu), although with the potential for a rising trend during the period. MOSWOC REFM output suggests below Active through the period, which is reasonable, but confidence becomes increasingly low.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	5	10	10	10
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

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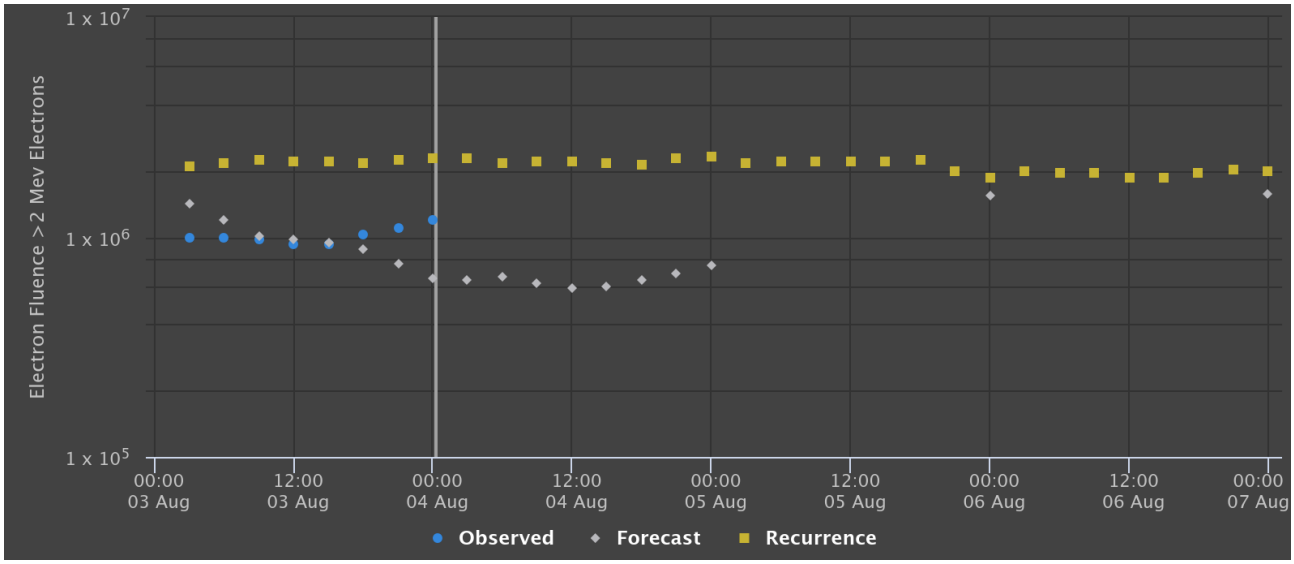
Figure 4: MOSWOC REFM showing a below Active forecast through the next three days, which is the most probable outcome.



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